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A V I A T I O N

IN THE

A N T A R C T I C

A Survey by

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To Captain Robert Scott must go, as he put it, "the honor of being the first aeronaut to make an ascent in the Antarctic Regions." On 4 February 1902, close by what was later to become famous as the Bay of Whales, he went up some 800 feet in a captive balloon and saw stretching away in the distance the undulations of the great Ross Ice Shelf. Not quite two months later, on 29 March, the German explorer, Dr. Erick von Drygalski, also ascended in a captive baloon to the height of 1,500 feet in the vicinity of the Gaussberg.[1]

No further use of aircraft occurred in the Antarctic until a decade after World War I,[2] although at least two expeditions in the early nineteen twenties were planned with aircraft in mind.[3] During these years, however,

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[1]R.F. Scott, The Voyage of the "Discovery", 2 vols., New York, 1907, I, pp. 145-8. H.R. Mill, The Siege of the South Pole, London, 1905, p. 422.

[2]Mawson acquired a Vickers monoplane equipped with "a special sledge-runner undercarriage" for the Australasian Antarctic Expedition (1911-14). Owing to an accident in Australia before departure, the machine was stripped of its wings and converted to an "air-tractor sledge." In this capacity, it was not conspicuously successful. D. Mawson, The Home of the Blizzard, 2 vols., London, 1915, I, p. 24; II, p. 6 ff.

[3]In 1920, Mr. J.L. Cope and Captain G.H. (later Sir Hubert) Wilkins planned to use airplanes declared surplus by the Royal Air Force to survey Edward VII Land, but lack of public support caused cancellation of this venture. W.L.G. Joerg, Brief History of Polar Exploration since the Introduction of Flying, New York, 1930, p. 3. Sir Ernest Shackleton purchased a small Avro seaplane for his last expedition, 1921-22, but, owing to a change in itinerary, the machine, which had been shipped to Capetown by mail steamer, was not used. Frank Wild, Shackleton's Last Voyage, New York, n.d., pp. 7-8, 46. Major C.R. Carr, who accompanied the expedition as aviator, appears to have been the first qualified pilot to enter the Antarctic, although he had no opportunity to demonstrate his specialty.

successful penetration of the Arctic by airplane had occurred, and in Alaska and Canada increasing numbers of pilots had acquired experience in cold weather operations. One of these, Mr. C. B. Eielson, with Sir Hubert Wilkins as passenger, made the first successful heavier-than-air flight in the Antarctic from Deception Island on 16 November 1928 with a wheel-equipped Lockheed-Vega monoplane. About a month later, 20 December 1928, the same pair proceeded some 600 miles down the Palmer Peninsula in the first really important aerial reconnaissance of Antarctica. It is notable that Eielson lifted his monoplane off a half-mile long runway laid out across the soft volcanic sand of Deception Island.[4]

Even as Eielson and Wilkins were carrying out their pioneer flights, a far better planned and equipped expedition under Commander (later Rear Admiral) Richard E. Byrd approached the Ross Sea side of Antarctica. Three aircraft -- a Ford tri-motor, a Fokker, and a Fairchild -- constituted the equipment for aerial exploration. All were ski-equipped for take-off and landing from snow surfaces.[5] Equally important was the instrumentation for accurate aerial navigation, much of it developed by Byrd himself, and the aerial mapping camera operated by Captain (later Colonel) Ashley C. McKinley.

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[4]Hubert Wilkins, "The Wilkins-Hearst Antarctic Expedition," The Geographical Review, vol. XIX, no. 3 (July 1929), pp. 353-356; also Joerg, Brief History, pp. 3-8. The geographical misinformation resulting from the 20 December flight took over ten years of work, largely on the ground, to contradict and should serve as a warning of the dangers of aerial observation unsupported by other evidence.

[5]The characteristics of these planes are set forth in R. E. Byrd, Little America, New York, 1930, pp. 32-33.

Not only the epic flight of 28-29 November 1929 over the South Pole but also the others across the Ross Ice Shelf and into Marie Byrd Land, as well as those in support of field parties, opened up a new era in the history of Antarctic exploration.[6] Since that time, the airplane has remained perhaps the single most important tool of the explorer in the discovery of hitherto unseen parts of the white continent.

In the autumn of 1929, Wilkins returned to the Antarctic. Unable this time to use Deception Island, he equipped his plane with floats and placed it aboard the RRS William Scoresby operated by Britain's Discovery Committee to carry on oceanographic and biological research. Taking off from the water at the edge of the pack, Wilkins' pilots were able to cross the belt of ice that frequently surrounds much of the continent and make important discoveries, particularly in the region of Charcot Island.[7] Ship-based operations by seaplanes became for the next twenty years one of the most important means for exploring large coastal areas. It was this method that Norwegian whalers used from 1930 on, particularly under Riiser-Larsen, in plotting the coast lines of Enderby and Queen Maud Lands.[8] This technique

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[6]The accomplishments of the First Byrd Antarctic Expedition may be studied most at length in Byrd's Little America (see note 5 above). For a useful summary of this, as of other twentieth century expeditions, see Walter Sullivan, Quest for a Continent, New York, 1957.

[7]H. Wilkins, "Further Antarctic Explorations," The Geographical Review, vol. XX, no. 3 (July 1930), pp. 357-388. A summary in Joerg, Brief History, pp. 8-11. In 1958, T.G.43.6 of Operation DEEP FREEZE III found the ice condition in the eastern part of the Bellingshausen Sea much as Wilkins had described it nearly two decades before.

[8]Joerg, Brief History, pp. 21-28; Sullivan, Quest for a Continent, pp. 109-113; and Lars Christensen, Such is the Antarctic, London, 1935, passim.

reached its greatest prewar success in the German Schwabenland Expedition of 1938-39 under Captain Alfred Ritscher. Using two ten-ton Dornier-Wal flying boats based on a catapult ship, the Germans obtained 11,600 aerial photographs in a little over two weeks. Lack of ground control, however, decreased the accuracy of the resultant mapping while the photographs themselves appear to have been among the war casualties.[9]

Thus, prior to World War II, three basic methods of flying had been tried in the Antarctic -- from land, from snow, and from the sea. The first had been used only on the Wilkins-Hearst Expedition and never from the continent itself. The Americans, Byrd and Ellsworth, were the principal proponents of ski-planes, which, in the case of the first, had required the most extensive base set-up ever seen in the area. This flight method had permitted them to achieve greater penetrations of the continent than anyone else. Ship-based operations had been the most widely practiced because they greatly reduced the logistics problem. No base construction ashore was required and both fuel and servicing were performed aboard ship under relatively favorable conditions. Even with large flying boats, however, exploration was pretty much limited to coastal areas and the immediately adjacent hinterland.

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[9] Sullivan, Quest for a Continent, pp. 124-27. Space and the fact that no new aviation techniques were introduced prohibit mention of other expeditions during the 1930s, including the Second Byrd Antarctic Expedition, which, like the first, made extensive use of aircraft, and the exploits of Mr. Lincoln Ellsworth. For these expeditions, see R. E. Byrd, Discovery, 1935; L. Ellsworth, Beyond Horizons, New York, 1937, and "My four Antarctic Expeditions," National Geographic Magazine, July 1939, pp. 129-138.

Conclusion of hostilities brought a resumption of interest in Antarctica.[10] In 1946, the United States Navy mounted the most elaborate expedition sent to the area up to this time. Known as Operation HIGHJUMP, it had assigned thirteen ships, including two seaplane tenders and an aircraft carrier, and a total of twenty-five airplanes.[1] Of particular interest were the six PBM Mariner flying boats, an equal number of R4D Dakotas, and six Sikorsky helicopters (HOS and HO3S). Full advantage was taken of new techniques developed during the war, particularly in the fields of electronics and photogrammetry.

Mariner operations in a large sense continued a development already well under way by 1939. The range of accomplishment, however, was very great. From some thirty-six mapping flights, the aircraft returned with 49,000 photographs. When added to those taken by the shore-based R4D's, they covered about 60 per cent of the coast line, a quarter of which was

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[10]Only those expeditions showing significant aviation developments will be discussed here. The use of light planes that have interchangeable float and ski installations has been commonplace on most foreign expeditions. For examples of some of the problems encountered by light planes and of their accomplishments, see John Giaver, The White Desert, New York, 1955, pp. 231-32, 235-36, and 239-45; Phillip Law and John Bechervaise, ANARE, Melbourne, 1957, pp. 24-26; and J. Glenn Dyer, Report of United States Observer with the Australian National Antarctic Research Expedition, 1956-57, mimeo.

[1]See Report of U. S. Navy Antarctic Development Project, 1947 (Operation HIGHJUMP), 10 June 1947, reproduced. A good short account also appears in Sullivan, Quest for a Continent, pp. 173-248. Sullivan accompanied the expedition as correspondent for the New York Times.

previously unseen.[2] One plane unfortunately crashed with the loss of three lives; otherwise no unusual difficulties were encountered.

Helicopters represented an innovation.[3] They were used largely for ice reconnaissance while in the pack and for searching out ice-free areas for the Mariners to take off and land, replacing in the first duty the small float planes used for this purpose on earlier expeditions.

The R4D's, Navy version of the commercial DC-3 transport plane, were flown to Little America on the Ross Ice Shelf from the aircraft carrier Philippine Sea. They used an ingenious wheel and ski combination to permit take-off from a carrier deck and landing on a snow surface. Once ashore, however, the wheels were removed, because they protruded through the skis and caused excessive drag. No special preparation of the landing area was required, although it was found that take-off was facilitated by dragging a strip with D-6 tractors to level the sastrugi. With JATO bottles, gross weights of over 33,000 pounds were lifted off unprepared snow. During the few weeks the R4D's operated from Little America, the air unit met no insolvable operating or maintenance problems. It made 39 flights and logged 260 hours in the air. At the end of the operation, the aircraft were left on the ice for use in future operations, which in fact never took place.

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[2]Much of this photography still remains unexploited for mapping purposes.

[3]The Second Byrd Antarctic Expedition (1933-35) had taken an Autogiro to Antarctica. This ancestor of the helicopter worked successfully until it crashed on 28 September 1934. Byrd, Discovery, pp. 240-41.

Part of the original project had been the construction of a strip for wheeled aircraft using Marston matting. Because of delays in reaching the Antarctic, insufficient time remained for a full-scale test. A small section of matting, however, was laid down and studies of snow compaction were made. The task force commander concluded that a compacted snow runway without matting could normally support an R4D, but that for heavy traffic and under certain climatic conditions additional strengthening might be needed. In an endorsement, the Commander in Chief, Atlantic Fleet, indicated his belief that an acceptable technique had been developed for building a strip on snow-covered glacial ice suitable for the operation of wheeled aircraft.

Nothing much came from this experiment at the time because the United States, except for a two-icebreaker expedition the following year, withdrew from the Antarctic until the International Geophysical Year program was inaugurated.[4] The nations active in the area operated on a comparatively limited basis and either dispensed with aircraft or used light planes. The Argentines, however, have for a number of years assigned a naval aeronautical unit to the Antarctic operating with flying boats, either Catalinas (PBY) or Mariners (PBM) from the sheltered lagoon of Deception Island.[5] The Falkland

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[4] For the Second United States Navy Antarctic Development Project, popularly known as Operation WINDMILL, see Sullivan, Quest for a Continent, pp. 249-261. The Ronne Antarctic Research Expedition (1947-48) made effective use of ski-equipped aircraft but added nothing to the technique of Antarctic flying. Finn Ronne, Antarctic Conquest, New York, 1949, see esp. pp. 143-45, 266-67.

[5] Lt. Barry C. Bishop, Report of the United States Observer with the Argentine Antarctic Expedition, 1956-57, mimeo. Ben Stotts, Report of the United States Observer with the Argentine Antarctic Expedition, 1957-58, mimeo.

Islands Dependencies Survey in 1955 contracted with a private company to make a photographic survey of parts of the Palmer Peninsula and the South Shetland Islands. This project carried out by Hunting Aerosurveys Ltd., flying from Deception Island in Cansos, a Canadian-built version of the United States Navy's Catalina, has proved most successful.[6]

Of greater import for the future was the Argentine resupply by air-drop of their station on Barry Island during the 1952-53 season. When ice conditions prevented ships from penetrating Marguerite Bay in March 1953, a long-range Avro-Lincoln of the Argentine Air Force flew nonstop from Rio Gallegos on the mainland of South America with essential food, medical supplies, and mail. Earlier in the season, similar aircraft from the same airfield had carried out aerial reconnaissance as far as Dundee and Gamma Islands off the northern portion of the Palmer Peninsula.[7] Although of limited coverage and partly of an emergency nature, these operations of long-range aircraft over Antarctica from a continental land mass pointed the way for more extended activity, especially if suitable landing areas could be established on the Antarctic continent itself.

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[6] For a brief summary, see "Falkland Islands and Dependencies Aerial Survey Expedition, 1955-57," The Polar Record, vol. 8, no. 58 (Jan. 1958), pp. 28-30.

[7] "Argentine Antarctic Expeditions, 1951-54," The Polar Record, vol. 8, no. 53 (May 1956), pp. 160-168. The following year, when similar ice conditions were encountered in Marguerite Bay, ship-based helicopters relieved Barry Island.

In planning for the Antarctic phase of the International Geophysical Year, the United States proposed to establish two scientific stations in the interior of the continent at the geographic South Pole and at approximately 80°S., 120°W. in Marie Byrd Land.[8] While the material for Byrd Station might be carried from the area of Little America by heavy tractor train, there existed no assurance that the South Pole could be reached by the same method. Only two parties had ever been there over land, one under Roald Amundsen and the other under Robert Scott, both in 1911-1912, while a third, led by Sir Ernest Shackleton, had ascended the Beardmore Glacier and almost reached the Pole in 1908-1909. Their accounts of the difficulties they encountered were not encouraging. Advances in flying techniques, however, made it possible that the materials for building the station and the bulk supplies for its support could be air-dropped, while ski-equipped planes flew in the men and delicate scientific instruments.

The success of this plan, however, depended upon two unknown factors. The first was the ability of large wheeled aircraft suitable for cargo operations to land and take off from an airstrip in the Antarctic. The second concerned the possibility of lighter ski-equipped planes being able to carry the men and equipment to and from the polar plateau. Range limitations made it impossible to operate over the South Pole from bases in New Zealand as the Argentines had done over Marguerite Bay from Rio Gallegos. Experience in the

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[8] See the report presented to the Rome meeting of the Comité Spécial de l'Année Géophysique Internationale (CSAGI), September 1954, in Bulletin d'Information No. 3 du Comité Spécial d l'Année Géophysique Internationale (C.S.A.G.I.), n.d., pp. 21-71.

Arctic, including flights to the Greenland Ice Cap, was encouraging, but the proof would only come when the plan was actually tried out.

The United States National Committee for the International Geophysical Year, its Antarctic subcommittee, and the Navy, to which had been assigned the logistic support of the program, went ahead on the assumption that these conditions could be met at the South Pole and "if necessary" in Marie Byrd Land.[9] For the air-drop operations, the Navy requested and obtained the assistance of the Air Force, but these planes would not be needed until the second year, 1956-57. For Operation DEEP FREEZE I, 1955-56, the Navy intended to try out two cargo-type aircraft on wheels and chose the R5D-3 Skymaster, a military version of the Douglas DC-4 commercial transport. In addition, it assigned two large patrol planes, of the P2V-2N (Neptune) type, equipped with a ski-wheel combination. A number of smaller aircraft capable of operating either with wheels or skis were also to be sent to the Antarctic by ship, but these planes presented no problems that had not already been met.[10]

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[9]United States National Committee for the International Geophysical Year, Antarctic Program, August 1955, mimeo. U. S. Navy Task Force 43, Report of Operation DEEP FREEZE I, October 1956, Part A to Annex I. The concept of operations from Operation Plan No. 1-55 of 1 July 1955 is here reproduced.

[10]U. S. Navy Task Force 43, Report of Operation DEEP FREEZE I, Part A to Annex I, Part A to Annex 4. The complete assignment of aircraft, except helicopters carried by the icebreakers, was as follows: 2 R5D-3 (wheels), 2 P2V-2N (ski-wheels), 2 R4D-5/6 (ski-wheels), 2 UF-1 (ski-wheels, boat hull), 4 UC-1 (ski-wheels), 3 HO4S-3 (helicopter). The R4D's, that were scheduled to fly in, turned back because of adverse winds and never did reach the operating area. R4D's succeeded in reaching Antarctica from New Zealand during Operation DEEP FREEZE II.

The spot selected for landing in Antarctica was in the neighborhood of Cape Armitage on the east side of McMurdo Sound. The winds in this area, it was believed, would keep the bay ice reasonably clear of snow, and, if the ice on inspection did not lend itself to use by heavy wheeled aircraft, a snow compacted runway would be constructed close by and tested by the P2V's before bringing in the R5D's.[1] This expedient, however, was found to be unnecessary, because, when the aircraft squadron commander arrived at McMurdo Sound by icebreaker on 17 December 1955, he quickly found a suitable landing area on the bay ice about five miles from Hut Point. When this intelligence was radioed to Christchurch, New Zealand, Commander Task Force 43 immediately ordered the flight and directed the ships of the force to take up stations along the route.[2]

On 20 December 1955, the R5D's and P2V's took off from Christchurch between 0456 and 0830. No unusual flight conditions were encountered en route, and all four planes arrived safely between 1912 and 2215. The flying time for the approximately 2200 miles varied from 13.5 hours for one of the R5D's to 14.3 for one of the P2V's. For the first time wheeled aircraft had flown from a land mass in the Southern Hemisphere and landed on the Antarctic Continent or, at least, alongside it.[3]

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[1] Ibid., Part A to Annex I.

[2] Ibid., Part C to Annex I. The ships were stationed at approximately 250-mile intervals.

[3] Ibid., Part B to Annex I summarizes the flight briefly. More details can be found in Part B to Annex IV.

Once arrived at McMurdo Sound, the pilots of the R5D's found operations "routine." One of them compared the matter of landing and take-off to flying "from any ice-covered runway."[4] During the period they remained in the area, the four aircraft did an immense amount of reconnaissance and exploratory work. In a series of flights between 3 and 13 January, they covered more than 23,000 miles and surveyed an area of approximately two million square miles. Included were flights over the South Pole, South Geomagnetic Pole, and the Pole of Inaccessibility. A P2V on 13 January crossed the continent from the Ross Sea to the Weddell Sea and return in 19 hours.[5] No attempt was made to land on the polar plateau, although a P2V stopped at Little America and demonstrated that it could operate on skis from the surface of the Ross Ice Shelf.[6]

As the principal objective of Operation DEEP FREEZE I was to construct the first bases for United States activities during the International Geophysical Year, no shore installation existed to support the aircraft. They fueled directly from the tanker USS NESPELEN and were serviced on the ice by maintenance crews.[7] The progressive deterioration of the bay ice brought

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[4] Ibid., Part B to Annex IV. The reports of the P2V pilots are not so explicit, but they too seem to have encountered no real difficulties.

[5] Ibid., Part B to Annex I, Part A and Part B to Annex IV. For a popular account, see Rear Admiral George J. Dufek, as told to Joseph E. Oglesby, "Operation DEEP FREEZE: Nine Great Flights," Pegasus, October 1956, pp. 1-7. This article has been condensed and reproduced in mimeographed form by the Office of the United States Antarctic Projects Officer.

[6] U. S. Navy Task Force, Report of Operation DEEP FREEZE I, Part B to Annex IV.

[7] Ibid., Part B to Annex IV. Actually, very little was done to the aircraft except to furnish them with fuel and lubricants.

operations of the heavy aircraft to an end in mid-January, and they were ordered back to New Zealand. The return flight was made without incident on 18 January.[8]

Experience on DEEP FREEZE I led to the inclusion in the Operation Plan for the following year of two basic assumptions. The first was that the runway at McMurdo Sound would be capable of accommodating aircraft up to the gross weight of the C-124 (Globemaster), 185,000 pounds. The second stated that landings and take-offs would be feasible at the South Pole for ski-equipped planes.[9] Both these assumptions turned out to be correct.

During the winter a runway was laid out at McMurdo Sound by clearing the snow from the bay ice. This proved to be a time-consuming procedure because of the frequency with which blizzards undid the work already accomplished. By mid-October, however, a 5,000-foot runway was completed and ready for the aircraft.[10]

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[8] Ibid., Part B to Annex I.

[9] U. S. Atlantic Fleet, TF-43, and ComNavSupFor Antarctica, Operation Plan 1-56, 1 July 1956, mimeo.

[10] U. S. Navy Task Force 43, Report on Operation DEEP FREEZE II, reproduced. This report, without recommendations, was reprinted as Appendix VII to House Report No. 1348, 85th Congress, International Geophysical Year: The Arctic, Antarctica, (Report of the Committee on Interstate and Foreign Commerce), Washington, 1958, (hereafter cited as House Report No. 1348). See pp. 151-152. Snow compaction tests showed this method of runway construction to be unsatisfactory.

As on the previous expedition, the Navy assigned both wheeled aircraft (2 R5D's) and ski-equipped planes (4 R4D's and a P2V) to be flown to McMurdo Sound from New Zealand. The first of these aircraft, an R5D, left Christchurch on 16 October 1956 and arrived without incident. The other planes, which followed the next day, were not so fortunate as the P2V crashed on landing with the loss of four lives. Eight United States Air Force C-124's were deployed to Christchurch and commenced the logistic support of McMurdo Sound on 20 October. All elements were in place for the air-drop of materials at the South Pole when it could be shown that the landing of personnel by ski-plane was practicable. On 31 October, an R4D, with Rear Admiral George J. Dufek, USN (Ret.) aboard, succeeded in coming down at the Pole and, after a brief stay, returned to McMurdo Sound. At the extreme low temperature encountered, -57°F., the R4D had only marginal take-off characteristics so that Admiral Dufek delayed the beginning of actual construction until the weather should grow more favorable.[1]

While awaiting better weather on the polar plateau, Air Force C-124's had helped to establish an emergency meteorological and refueling station at the foot of Liv Glacier. On 19 November, Navy construction personnel arrived at the Pole by ski-equipped R4D, and the Air Force began the delivery of building materials and supplies. The same aircraft also supported the heavy tractor trains on the route from Little America to Byrd Station and air-dropped fuel at the latter point.[2]

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[1]House Report No. 1348, pp. 133, 147. A detailed account of the flight of 31 October 1956 may be found in Rear Admiral G. J. Dufek, Operation Deepfreeze, New York, 1957, p. 187 ff. Admiral Dufek and the plane crew thus became the first men to stand at the South Pole since the ill-fated Captain Scott in 1912.

[2]House Report No. 1348, pp. 135, 148.

By mid-December, the runway at McMurdo Sound deteriorated to the point where the C-124's had to be withdrawn. The last of them left for New Zealand on 19 December to wait until colder weather would permit the refreezing of the holes in the ice.[3] During this period of operation, they had delivered approximately 503 tons of cargo to the South Pole, 36 tons to Byrd Station, 12 tons to the trail party, and 27 tons to the station at the foot of the Liv Glacier, or about 60 per cent of the scheduled material.[4] This record had been achieved at the cost of three accidents to aircraft one of which was a total loss, except for parts and instruments that were used to repair the others.[5]

For more than a month after the departure of the C-124's the runway continued to deteriorate. Early in February an ice expert in the employ of the Army began the repair of the ice strip by filling the holes with a mixture of snow, chopped ice, and water which subsequently froze. On 9 February, the first C-124 returned from New Zealand and by 24 February the task of supplying the South Pole and Byrd Stations had been completed, thus carrying out the planned operations for the year.[6]

On DEEP FREEZE III (1957-58) and again on DEEP FREEZE IV (1958-59), the Air Force resupplied the South Pole and Byrd Stations and assisted in setting

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[3] Ibid., p. 148.

[4] Officer in Charge, United States Antarctic Programs, Operation DEEP FREEZE II, Outstanding Occurrences, mimeo.

[5] House Report No. 1348, p. 147.

[6] Ibid., pp. 133, 148.

up the emergency weather and refueling station at the foot of the Beardmore Glacier. Both seasons, however, saw the end of cargo operations in December as the ice in McMurdo Sound first deteriorated and then broke out.[7] For the 1958-59 season an ice strip was for the first time laid out in Moubray Bay off Hallett Station, largely to serve as an alternate landing field, and on 9 October Hallett played host to an R4D and 4 C-124's that were unable to use McMurdo Sound because of weather conditions.[8]

Each year the Navy has continued to assign both wheeled and ski-equipped aircraft to the operation and has maintained R4D's , UC-1's, and helicopters in the area, at Little America, McMurdo Sound, and Ellsworth Station. Helicopters are also carried by all United States icebreakers. Many foreign ships also carry this type of aircraft, and foreign expeditions operate aircraft on skis and floats, the largest being the IL-12's used by the Soviet Union. While these airplanes play an indispensible role in

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[7]U.S. Navy Task Force 43, Report of Operation DEEP FREEZE III, reproduced. Public Information Office, U.S. Naval Support Force, Antarctica, Chronology of Events during Operation DEEP FREEZE (September 1954 - April 1959), mimeo. A C-124 landed at McMurdo Sound on 11 February 1958 and returned to New Zealand immediately. Another, which arrived on 15 February to complete the air drops at the South Pole, was forced to leave the next day because of the imminent breakup of the ice. On 6 January 1959 an R5D landed at McMurdo to pick up the dead and injured from an Otter (UC-1) that had crashed at Marble Point.

[8]Chronology of Events during Operation DEEP FREEZE. On 16 October 1958, a C-124 crashed about 30 miles from Cape Hallett, and the strip was used during the subsequent rescue operations.

exploration and logistic support, their operation follows patterns long since developed.[9] On 22 December 1956, the Chilean national airline made the first flight over Antarctica carrying paying passengers but without landing.[10] Less than a year later, on 15 October 1957, a Pan American Airways Stratocruiser on a charter flight landed at McMurdo Sound, the first commercial airplane to land in the Antarctic.[1]

The success of the United States in establishing and maintaining the South Pole and Byrd Stations clearly demonstrated the value of a large cargo aircraft in the Antarctic. The experience of four years, however, underlined how short an operating season existed. Flying in and out of the continent was impossible during the long winter night.[2] In the summer, the ice tended to deteriorate and often broke out. From the bay ice of

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[9] In January and February 1959, the Japanese employed large helicopters to supply the Syowa Base from distances of 40 and 100 miles when their expedition ship was unable to penetrate the ice pack. D. Meloy, Report of United States Observer with the Japanese Antarctic Expedition, 1958-1959, mimeo.

[10] James O'Neal, Report of United States Observer with the Chilean Antarctic Expedition, 1956-1957, mimeo.

[1] U.S. Navy Task Force 43, Report of Operation DEEP FREEZE III. A pleasing, if not technically significant, innovation was the inclusion among the crew of two hostesses.

[2] Even with ski-equipped aircraft permanently stationed in the area, night flying has been rare, although not unknown. Temperatures are extremely low, storms frequent, and navigational aids, so important to night flying elsewhere, very scarce.

McMurdo Sound, the sure operating season had been from 1 October to early December. After the latter date, landing and take-off might be possible but could not be counted on. To undertake flying during the period which occured before ships could penetrate the ice pack, it was necessary to put personnel, equipment, and fuel into a station the previous year and to maintain them in a relatively inactive status through the long winter night. Other climatic factors, however, such as visibility and ceiling, permited a considerably longer flying season. As long as the United States continued to support inland stations with heavy cargo aircraft, the use of bay-ice runways would be both expensive and relatively inefficient.

To escape from this dilemma, two possibilities existed. The first was the development of a ski-equipped aircraft with capacity and performance similar to the C-124. The second required the construction of runways on land, by no means an impossible, although a somewhat expensive, undertaking. A suitable area for such an installation has been found at Marble Point on the western side of McMurdo Sound, and another reported close to Australia's Davis Station. An engineering survey was made at Marble Point and a short, 1,700-foot, dirt runway laid out there.

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[3] U.S. Navy Task Force 43, Report of Operation DEEP FREEZE III. J. Glenn Dyer, Report of United States Observer with the Australian National Antarctic Research Expedition (Dec. 10, 1956 to March 19, 1957). The first landing at Marble Point occurred on 31 January 1958 in a UC-1 (Otter) carrying Rear Admiral Dufek and Sir Edmund Hillary.

The solution for the time being at least came about with the development of a large cargo plane capable of landing and taking off on skis. The particular aircraft was the C-130, Hercules, built by Lockheed for the United States Air Force and adapted for polar operations. This version, designated C-130D, was essentially a ski-equipped modification of the original C-130A.[4] First tests of the aircraft during the summer of 1958 in Greenland had indicated some weaknesses in the ski assembly, but Lockheed had been able to make the necessary corrections.

Commander U.S. Naval Support Force, Antarctica, had become aware of the existence of this plane and had pressed the Navy Department to obtain a few. At first, this effort had met with little success, but in the late spring of 1959, funds to purchase four aircraft became available by reprogramming from other projects. By this time, however, Lockheed had in production an improved model with considerably greater range and this is what the Navy received, its order having simply been added to an existing Air Force contract. Lockheed also incorporated the lessons learned in Greenland. The Navy accepted the first of the four Hercules, designated C-130BL on 17 August 1960, and the others followed shortly.

While the aircraft were still in production, a serious situation had developed at Byrd and South Pole Stations both of which were badly in need

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[4] For development, see Lockheed Aircraft Corporation, Georgia Division, The Ski Equipped C-130 Aircraft, SER/207, April 4, 1958, reproduced. Salient characteristics that made the C-130 especially suited to the Antarctic are set forth in Bulletin of the United States Antarctic Projects Officer (hereafter cited as Bulletin USAPO), Vol. I, No. 5, p. 4.

of repair. Building materials were not available in the Antarctic and could not be made so until the arrival of the ships in December, at which time the C-124s used for airdrop would have ceased operating. The Navy, therefore, requested the Air Force to send the 61st Troop Carrier Squadron (Medium), equipped with C-130Ds, to Antarctica late in January. This unit had operated successfully in Greenland during the summer of 1959 and was well-qualified both to test the aircraft under Antarctic conditions and to instruct naval personnel in their use.[5]

The mission was a complete success. The squadron departed Christchurch, New Zealand, on 23 January and made the first landing at Byrd Station two days later. Flights to the South Pole began on 27 January. The last logistic flight was completed on 5 February, and the unit returned to Christchurch on 7 February. During the brief stay in the Antarctic, 30 landings were made at Byrd and 28 at the South Pole and a total of 406.9 tons delivered to the two inland stations.[6] Naval Ground personnel worked alongside airmen loading the planes at McMurdo, and naval flight crews accompanied the aircraft to the inland stations.[7]

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[5]Interview with Rear Admiral David M. Tyree, USN, 28 May 1963.

[6]C.O. 61st Troop Carrier Squadron (Medium), Mission Report, Operation "Ice Flow," 15 March 1960, mimeo.

[7]Interview with Rear Admiral David M. Tyree, USN, 28 May 1963.

On DEEP FREEZE 62, the Navy put its four C-130BLs into the field. Three of them were assigned to operations, and one was used in a special test program to determine the capabilities of the ski assembly. The test program rapidly showed that the earlier weaknesses had been remedied and that landing restrictions, imposed by the Air Force as result of its earlier Greenland experience, were inapplicable to the Navy version. Landings on open snow areas were feasible, a fact that was to have a revolutionary effect on the techniques of Antarctic field operations.

As foreshadowed in 1960, the C-130s performed admirably. The standard loads were 22,000 pounds for Byrd Station and 24,00 pounds for the South Pole. With the ability to land on unprepared surfaces demonstrated, a C-130 on 10 December 1960, took an entire field party, which, with its equipment, weighed 10 tons, from McMurdo Sound to the Eights Coast, a round-trip distance of about 2,700 miles. After all aircraft and ships had left the Antarctic in the southern autumn of 1961, an ill scientist at Byrd Station required medical evacuation. A C-130 returned to the continent on 9 April and successfully completed the mission the following day, thus opening up the possibility of extending the operating season.[8]

The two succeeding years witnessed an ever expanding use of the C-130s either by themselves or in cooperation with other aircraft. In addition to supply of the inland stations, the C-130s on DEEP FREEZE 62 put a traverse party into the field between 25 and 26 November 1961. A few days

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[8]U.S. Navy Air Development Squadron SIX (VX-6), Report of Operation DEEP FREEZE 61, 5 May 1961, mimeo.

later, construction began on a summer scientific station, named Sky-Hi, at 75°15'S, 77°06'W. This operation involved one flight by a Dakota (R4D) from Byrd Station and 5 Navy C-130 and 6 Air Force C-124 flights from McMurdo Sound. The crew of the R4D selected and marked the landing site, smoothed it off somewhat with hand tools, provided weather information, and served as a radio link. The C-130s brought in building materials, scientific equipment, and living supplies, while the C-124s air-dropped fuel.[9]

The method used at Sky-Hi was applicable to even more ambitious projects. At the same site, a wintering-over station was set up during DEEP FREEZE 63. Again, Air Force C-124s brought in the fuel, 270 tons of it on 29 flights. Instead, however, of dropping construction materials as had occurred at the South Pole Station in 1956-57 or flying them in with C-130s as had been done for the building of the new Byrd Station in 1960-61, pre-fabricated units, tailored to fit in the cargo bay of a C-130 were obtained. Each unit was fitted for its special function before shipment from the United States, and then transported to McMurdo Sound by ship. The journey from McMurdo to the site was by air. As the units were skid mounted, they could be easily hauled from the aircraft to their exact location. In 20 days during January 1963, eight of these units were formed

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[9] U.S. Navy Air Development Squadron SIX (VX-6), Report of Operation DEEP FREEZE 62, 12 April 1962, mimeo. U.S. Air Force Ninth Troop Carrier Squadron (Heavy), Final Report, Operation DEEP FREEZE 62, n.d., reproduced. These significant accomplishments should not blind the reader to the fact that the principal effort of both C-124s and C-130s remained the support and resupply of permanent inland stations.

into a main station complex, and three other detached units were set up as scientific buildings. Named after James Eights, the first United States scientist to visit Antarctica, the station also has the advantage that it may be picked up and moved to another site if, in the future, that should seem desirable. In all, the C-130s made 45 trips bringing in not only the buildings but also other equipment, supplies, and personnel.[10]

The employment of C-130s to place and support scientific parties in the field follows a technique that goes back to the first Byrd expedition and in recent years has been carried on by many types of aircraft on both United States and foreign expeditions. The C-130, however, greatly increases the area open to scientific investigation. The Air Force has also adapted the C-130 to aerial photography, and the use of this type of aircraft as a replacement for the P2V, would provide a plane of improved range and altitude characteristics.[1] Even without photographic equipment, the Hercules has become a tool of exploration. On 22 February 1963, one of these planes took off from McMurdo Sound and proceeded to the South Pole by way of the Beardmore Glacier; from the Pole it flew to the vicinity of the Shackleton Range and then turned southeastward to the Pole of Inaccessibility, from which point it returned to McMurdo Sound. The flight

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[10] Bulletin USAPO, Vol. IV, No. 6, pp. 7-11; No. 7, p. 17.

[1] Interview with Rear Admiral David M. Tyree, USN, 28 May 1963. U.S. Navy Air Development Squadron SIX (VX-6), Report of DEEP FREEZE 63, 23 April 1963, mimeo.

covered a total distance of 3470 statute miles, much of it over territory not previously seen.[2]

The United States has led in the development of aviation in the Antarctic, but other countries have made contributions. Noteworthy was the Japanese relief and resupply of Syowa Base by helicopter from a ship located from 40 to 100 miles offshore, demonstrating the feasibility of supporting without an icebreaker a small expedition in an area difficult of access.[3] During the 1961-62 season, both Argentina and the Soviet Union flew into the continent from outside. The Argentines taking off from Rio Gallegos in southern Patagonia, went by way of the Larsen Ice Shelf to Ellsworth Station and the South Pole in two DC-3s. The Soviets used two turbo-propelled planes and reached Mirnyy from New Zealand, staging through McMurdo Sound. The return journey was made directly from Mirnyy to Christchurch, a distance of 3,200 miles.[4] Although this use of long range, heavy aircraft seemed a natural evolution on the part of the Soviets, they did not repeat the flights the following season and have not thus far adopted the United States pattern of operations.

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[2]Ibid. U.S. Navy, Commander Naval Support Force, Antarctica, Press Release, McMurdo Station Antarctica, 22 Feb. 1963.

[3]See p. 17, footnote 9. The Japanese adopted the technique after the expedition ship Soya, even with the assistance of USS BURTON ISLAND, was unable to reach the base in February 1956. The Japanese continued to supply Syowa in this manner until they withdrew from the Antarctic in 1962.

[4]Bulletin USAPO, Vol. III, No. 5, pp. 2-3. Antarctic, Vol. 3, No. 1 (March 1962), pp. 24-25, 30. The Argentines had previously flown a Beechcraft to the Palmer Peninsula in 1958.

The objective of the United States development has been to provide better support for its Antarctic program. Combined with air transport between the United States and Antarctica by way of New Zealand, aviation made possible summer scientific programs that would have been unthinkable a generation ago. Formerly, a person wishing to do research in the field had to come to Antarctica one year and remain over the winter to take advantage of the full summer season. Then, if his project called for work at any distance from a fixed base, he must spend a large segment of his precious time in the slow and tedious task of going to and fro, burdened with the fuel, food, and equipment for the entire trip.

Today scientists can be brought into the Antarctic, set up in the field, moved from place to place and returned to the United States within three or four months. As resupply can be effected in the field, it is no longer necessary for a party to employ heavy tractors to haul quantities of fuel and food. Motor toboggans and other light vehicles suffice for many small groups. Larger parties using heavy forms of transport can carry a greater amount of scientific equipment and operate more comfortably than ever before. Because less effort is required to sustain life, greater efficiency in carrying on scientific work has been achieved. As a result, summer scientific programs in the field have increased in number and importance.[5]

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[5] Bulletin, USAPO, Vol. III, Nos. 9-10, pp. 18074, reviews the 1961-1962 scientific program and contains numerous examples of this trend.

The future of aviation will probably be along lines already laid down. Longer range aircraft for logistic support would be useful.[6] Navigational aids and meteorological services, although improved in recent years, are not available to the same extent as in other parts of the world and would have to be increased if commercial flying over the Antarctic were undertaken.[7] Helicopters have proved enormously useful, but in the past limited range and altitude performance have restricted their activity to coastal areas. The introduction of turbine-powered helicopters during the 1961-62 season for use on a special project pointed the way toward overcoming the altitude problem, but range still left something to be desired.[8]

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[6]The flight to Eights Station from McMurdo extended the C-130s to their full range with the loads carried. It was customary for the planes to stop at Byrd to obtain fuel on the return flight. U.S. Navy Air Development Squadron SIX (VX-6), Report on DEEP FREEZE 63, 23 April 1963, mimeo.

[7]The feasibility of such flights using McMurdo as a fueling base was demonstrated by a Super-Constellation of the United States Navy's Project MAGNET (Airborne Magnetic Survey), which during November 1962 flew from New Zealand to McMurdo and from the latter place to Punta Arenas, Chile, by way of the South Pole, Bulletin USAPO, Vol. IV, No. 8, p. 13-14.

[8]This helicopter unit, furnished by the U.S. Army Transport Board, supported a scientific survey of the Victoria Land mountains to install accurate geodetic control. They penetrated areas inaccessible to other types of aircraft and difficult of access on foot or by dog team. The support of the helicopter unit, however, required rather intricate logistic arrangements employing naval aircraft to bring in supplies and establish and move the base camp. U.S. Navy Air Development Squadron (VX-6), Report of Operation DEEP FREEZE 62, mimeo.; same Report of Operation DEEP FREEZE 63, mimeo.

On DEEP FREEZE 63, the United States Navy equipped two C-130s with internal fuselage tanks for the bulk transport of fuel. Loaded with diesel or aircraft fuel, these aircraft could land at inland stations and transfer their contents to fuel tanks or bladders, thus saving all the trouble and expense involved in the use of fuel drums. The one test of this system carried out during the operating season was successful, and it was deemed feasible.[9]

Perhaps space flight transcends what we think of as aviation. Many scientists, however, eagerly await the day of the sattelite in polar orbit. From it, they may learn for example not only more about the upper atmosphere but also a great deal, still unknown, about the seasonal coverage fluctuations of sea ice on the waters about Antarctica. In the meantime, manned aircraft will continue to go about their tasks of logistic support of inland stations, transport of scientific field parties, and exploration of areas hitherto imperfectly seen or not seen at all.

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[9]U.S. Navy Air Development Squadron SIX (VX-6), Report of Operation DEEP FREEZE 63, mimeo. This system would save both on drums and parachutes, which in the past have not been recoverable. Fewer personnel would be required at McMurdo to prepare fuel for transportation, and at the inland stations small complements would be spared the arduous task of recovering and caching the drums.

Great strides have been made since Scott went aloft in his balloon, but flying in the Antarctic is still dangerous,[10] and it will undoubtedly remain so no matter how great the improvements in machines, equipment, and auxilliary services. The successful use of aviation in the future as in the past will depend upon the skill, experience, and courage of the men who man and service the aircraft.

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[10] Of 29 United States fatalities in the Antarctic since 1946, 22 have occurred in aircraft accidents. United States Antarctic Projects Officer, The United States in the Antarctic, 1820-1962, Washington, 1962, p. 34.

NOTE ON AIRCRAFT DESIGNATION

On 18 September 1962, the United States Army, Navy, and Air Force adopted a uniform system for the designation of aircraft. The new system is basically that previously in use by the Air Force. As a result, naval aircraft have received new designations. The table below indicates old and new designations of the principal aircraft mentioned in the text.

Old Designation	New Designation	Name
C-124A	C-124A	Globemaster
C-130A	C-130A	Hercules
C-130BL	LC-130F	Hercules
P2V-7	LP-2J	Neptune
R7V	C121J	Super-Constellation
R4D	LC47J/LC-117D	Dakota
R5D-3	C54Q	Skymaster